

Chapter 7

Linear Programming



Copy & Complete these questions:

What job(s) would you like to have?

What job(s) could you get now?

Why is there a difference?

- experience
- time
- education
- criminal record
- age
-

Why would you want a job?

- money
- pension
- health care
- work experience
- interest.

- What would be some limitations to making the greatest amount of money?

- \$/hour
- experience
- years in job
- age.
- time
- location
- education
- position
- compensation

What are some different ways that you could be paid?

- * \$ / hour
- ton mile
- \$ / day
- * commission
- * salary

7.1 – Exploring an Optimization Problem

- Constraint – a restriction on the allowable values of a variable in a problem

Example: Only have 20 hrs. to work in a week, this is a constraint on the variable time.

- Investigation 1 & 2 together
- Check your understanding
- Page 308, #7-9

Investigation 1

Read over opening paragraph on page 306

What do we know?

- \$13.50 per couch bundle
- 2 hrs. per couch bundle
- \$5.50 per chair bundle
- 45 mins per chair bundle.
- she makes the fraction she finishes.

What constraints do we have?

- time available to work.
- type of material
- amount of material
- employer requires
- breaks
- taxes.

Classwork/Homework

1. Answer procedure questions Pg. 306 *A, B, C*
2. Answer investigation questions Pg. 307

→ Open your text and take out your work.

A.) $\frac{24 \text{ hrs.} - \text{week}}{\hookrightarrow 12 \text{ couches}} \times \$13.50 = \$324.00$

$\frac{10 \text{ hrs.} - \text{week}}{\hookrightarrow 5 \text{ couches}} \times \$13.50 = \$67.50$

$\frac{20 \text{ hrs.} - \text{week}}{\hookrightarrow 4 \text{ couches (8 hrs.)} \times \$13.50 = \$54.00}$
 $\hookrightarrow 16 \text{ chairs (12 hrs.)} \times \$5.50 = \$88.00$
 $\hookrightarrow \times 0.75$
 $\$142.00$

→ $\frac{10 \text{ hrs.}}{\hookrightarrow 13.3 \text{ chairs}} \times \$5.50 = \$73.33$

→ $\frac{2 \text{ hrs.}}{\hookrightarrow 1 \text{ couch}} \times \13.50
 $\hookrightarrow 2.7 \text{ chairs} \times \$5.50 = \$14.67$

- B.) trial + error
- equation
- table of values
- graph.

C.)

$I = 5.50n + 13.50c$

Investigation #1 (Pg.306)

ANSWERS

A. Answers are limited by time (maximum money earned depends directly on time).

B. She can calculate an answer by solving an equation, trial and error, table of values, or a graph.

- find the answer by finding the sum of couch bundles made and the chair bundles made.

$I = 5.5b + 13.5n$ (b is the number of chairs and n is the number of couches)

C. Possible constraints:

- time in a day
- time in a week
- amount of material given
- number of chairs and number of couches that need to be made
- number of bundles required by the manufacturer
- the customer base
- the cost of chair and couch material
- the available material and cutting tools
- - the number of employees

Pg. 307 #1-3

#1. time 12 hrs \rightarrow week

3 combinations

- couches - \$81.00
6 x 13.50

- chairs $(12 \div 0.75) = 16 \times 5.50 =$ \$88.00

- 3 couches (6 hrs.) x 13.50 = \$40.50

8 chairs (6 hrs) x 5.50 = \$44.00

\$84.50

#3.

Pg. 307
4-6

Focus A (Page 307)

Pg. 308 #7

#4) 5 hrs

$$\rightarrow \begin{array}{l} 2 \text{ couches} + 1 \text{ chair} \\ 4 \text{ hrs.} \quad 0.75 \text{ hrs.} \\ 27.00 \quad 5.50 \end{array} = \$32.50$$

$$\rightarrow \begin{array}{l} 4 \text{ chairs} + 1 \text{ couch} \\ 3 \text{ hrs.} \quad 2 \text{ hrs.} \\ 22.00 \quad 13.50 \end{array} = \$35.50$$

$$\rightarrow \begin{array}{l} 2.5 \text{ couches} \\ 5 \text{ hrs.} \end{array} = \$33.75$$

$$+ \rightarrow \begin{array}{l} 6.6 \text{ chairs} \\ 5 \text{ hrs.} \end{array} = \textcircled{\$36.30}$$

#5) $36.30 \times 5 = \$181.50$

#6) a) 4 hrs. → makes less

b) 6 hrs. → more money

c) i) homework - 1 hr.

sleeping - 8 hr.

eat - 0.5 hr.

free time - 3 hr.

School - 9.5 hr.

sports - 2 hr. +

24 hrs.

\$0

i) \$0

iii) sports

Pg. 308

#7

a) - 2000 ha

- plant no more than 1500 ha of lettuce
- plant no more than 1000 ha of corn.
- satisfy customer demand.

b) 1000 lettuce + 1000 corn

1500 " + 500 corn

1750 " + 750 "

c) 1 " 1999 " NO

d) same amount 2500 ha.

7.2 – Exploring Possible Solutions

- Feasible solution – any solution to a problem that is possible within the constraints given



Focus B

- Let's look at this together!
- Complete Investigation 3
- Check your Understanding
- Page 314 #12-18

Focus B (Pg. 310)

Organize the information (constraints) given on Pg. 310 and the ones given on Pg. 306 into the following table:

CONSTRAINT	TIME	SPECIFICS
Bundles	2 weeks	At least _____ Couch Bundles
		At least _____ Chair Bundles
Time	1 week	Work a Maximum of _____ hours
	n/a	_____ Hours per Chair
	n/a	_____ Hours per Couch
Material	2 weeks	Maximum of _____ m
	n/a	_____ m for a Chair
	n/a	_____ m for a Couch

Focus B (Pg. 310)

Organize the information (constraints) given on Pg. 310 and the ones given on Pg. 306 into the following table:

#

CONSTRAINT	TIME	SPECIFICS
Bundles	2 weeks	At least <u>10</u> Couch Bundles
		At least <u>8</u> Chair Bundles
Time	1 week	Work a Maximum of <u>18</u> hours
	n/a	<u>0.75</u> Hours per Chair
	n/a	<u>2</u> Hours per Couch
Material	2 weeks	Maximum of <u>110</u> m
	n/a	<u>3</u> m for a Chair
	n/a	<u>5</u> m for a Couch

Focus B - Question 2 Copy & Complete

Copy & Complete

-Create 5 solutions that are possible and 5 that are not possible

[illegible]

Couch	Chair	Y/N	Couch	chair	Y/N
7	6	N	12	11	Y
19	9	N	9	8	N
12	10	Y	13	8	Y
14	10	Y	14	11	N
16	14	N	10	20	N Y
15	11	N	10	21	N
13	13	Y	11	19	N
12	12	Y	11.5	15	Y
11	11	Y	20	3	N
10	10	Y	5	5	N
10	11	Y	5	3	N
14	14	N	14	8	Y
			15	12	N

<u>Couch</u>	<u>chair</u>	<u>Y/N</u>
14.5	8	Y
14.5	9	Y
20	20	N
50	50	N
30	30	N
40	40	N
1	1	N
2	2	N
11	2	N
10	9	Y
20	15	N
10	10	Y

11.5	9	Y
19	15	N
10	12	Y
8	26.5	N
11.5	10	Y
15	12	N
16	9	N
13	11.5	Y
12	12	Y
50	15	N
11	11	Y
11	9.5	Y

Period 3

couch	chair	Y/N			
11	11	Y	10	7	N
14	19	N	12	10	Y
		Y	13	11	Y
10.5	8.5		14	10	Y
15	14	N	15	15	N
		Y	20	4	N
10	20		20	21	N
12	9	Y	13	8	Y
10	10	Y	11.5	10.5	N Y
13	14	N	19	20	N
9	8	N	12	12	Y
15.5	18	N	13	13	Y
13	13.5	N	14	14	N N
14	15	N	12	10	Y
16	20	N	13	10	Y
11	9	Y	14	19	N
13.5	9	Y	6	7	N

To determine if the solution satisfies the constraints or not:

Look at the table of constraints and see if all were met in your solution.

You need at least 30 solutions (15 must satisfy the constraints)

---> Get the extras that you need from your classmates! Make sure that they are different ones than you have used.

Investigation #3 (Page 311)

You need at least 30 solutions (15 must satisfy the constraints)

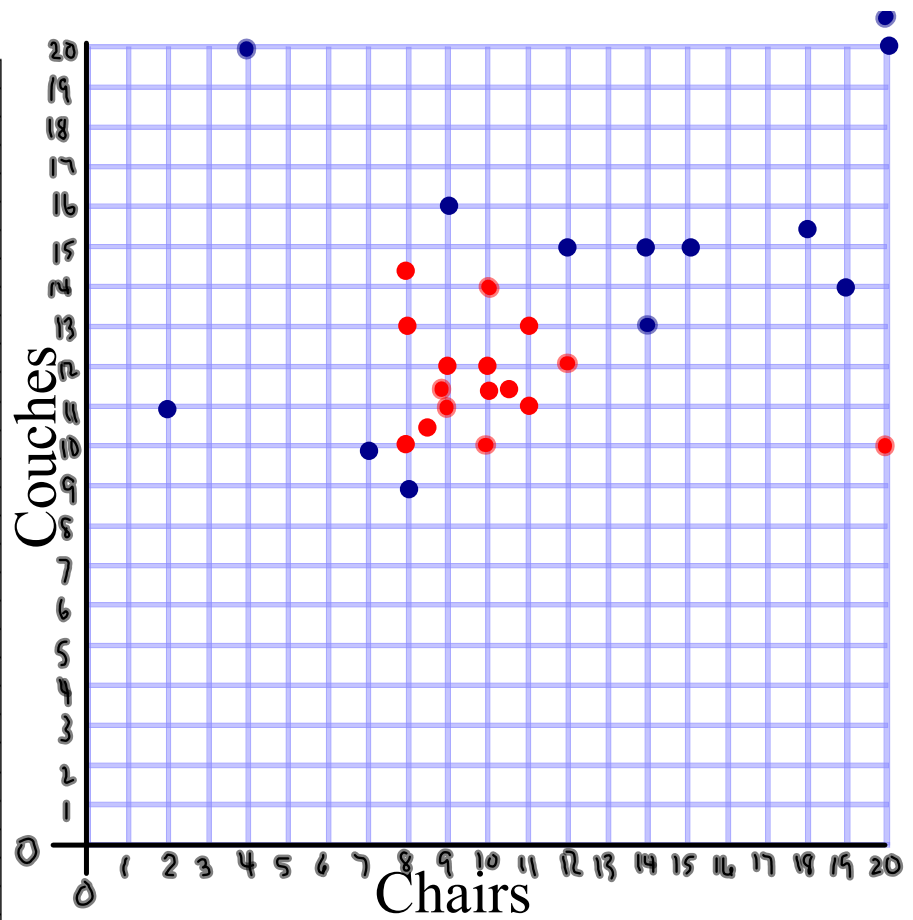
---> Get the extras that you need from your classmates! Make sure that they are different ones than you have used.

- Make a graph
 - -on your x-axis: number of chairs
 - -on your y-axis: number of couches
- Plot your 30 points on your graph
 - use red to plot the points that satisfy the constraints and blue for the data that do not satisfy the constraints.

Yes - ●
No - ●

- Answer Procedure Step C & D Pg.311 and numbers 5 & 6 of the investigation questions.

	x	y	
	Chair	Couch	Y/N
1	11	11	Y ●
2	8.5	10.5	Y ●
3	20	10	Y ●
4	9	12	Y ●
5	10	10	Y ●
6	10	12	Y ●
7	11	13	Y ●
8	10	14	Y ●
9	8	13	Y ●
10	8	10	Y ●
11	10	11.5	Y ●
12	8	14.5	Y ●
13	12	12	Y ●
14	9	11.5	Y ●
15	9	11	Y ●
1	19	14	N ●
2	14	15	N ●
3	14	13	N ●
4	8	9	N ●
5	18	15.5	N ●
6	7	10	N ●
7	15	15	N ●
8	4	20	N ●
9	21	20	N ●
10	10.5	11.5	N ●
11	20	20	N ●
12	2	11	N ●
13	9	16	N ●
14	12	15	N ●
15	2	11	N ●



When you are done:

- Answer procedure questions on Pg.311 (C&D)
- Answer Investigation questions on Pg. 311 (5 & 6)

a) Inequality
 $x \geq 8$

If you finish this:

- Begin Investigation 3, Part B Page 312 (A & B)

different paper for each and
use same scale.

**ALL OF THIS WILL HAVE TO BE
COMPLETED AND HANDED IN NEXT WEEK**

Please take out your work from last day!

- Remember that you will need to hand in the following:

- Table filled out
 - Graph of the 30 points
 - Questions Pg. 311 (C, D, 5, 6)
 - (Today) Pg. 312-313 (A, B, C, #7, #8)
- Handwritten notes in red:
- Feasible
↳ yes
 - infinite
↳ unlimited
- A red arrow points from the word "Feasible" to the word "infinite". A red arrow points from the word "infinite" to the word "unlimited". A red arrow points from the word "unlimited" to the word "Feasible".

- Feasible solution – any solution to a problem that is possible within the constraints given

• Inequality - a mathematical statement that shows that two numerical or variable expressions are not always equal

- Ex: $3x < 12$ is an inequality

copy { $x < 3$ less than
 $>$ greater than
 \leq less than or equal to
 \geq greater than or equal to

Turn to Pg. 312

- A) • Write an inequality for: $x \geq 8$
 - at least 8 chair bundles
 let "x" stand for # of chairs

- Graph all the points that you have that satisfy this constraint (all that have at least 8 chairs)

- B) • Write an inequality for: $y \geq 10$
 - at least 10 couch bundles
 let "y" stand for # of couches

- Graph all the points that satisfy this constraint

* For the graphs A + B, make sure to do each on a separate piece of graph paper and use the same scale for both.

NOTE:

- A "boundary line" is like your property line. It would show you the limits of your land.
- For Part "C" → you do need to create another graph.

Instructions Pg. 313 # 7 & 8

#7) Inequality that satisfies:

- 110m of fabric
- 3m for a chair (let this be "x")
- 5m for a couch (let this be "y")

$$3x + 5y \leq 110$$



#8) Inequality that satisfies:

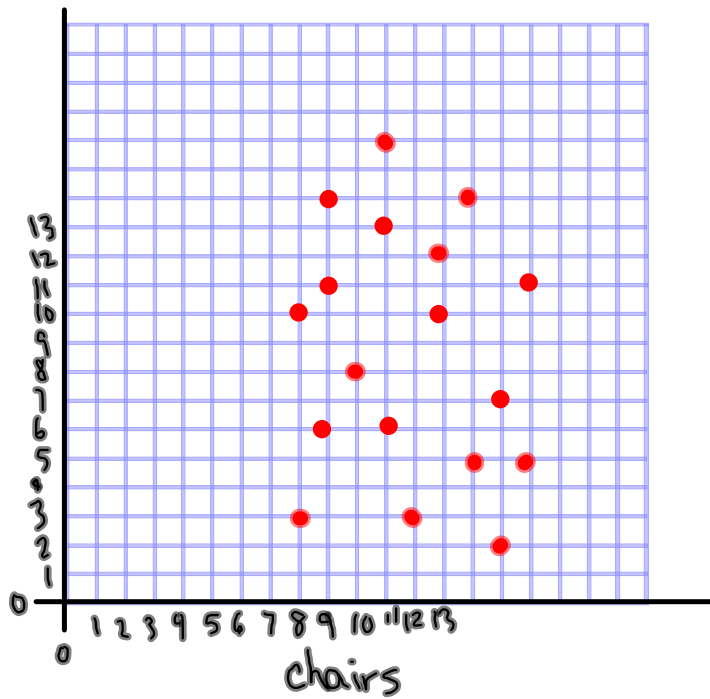
- Max. 36 hrs.
- 45 mins for a chair
- 2 hr. for a couch.

$$0.75x + 2y \leq 36$$

A)

Pg. 312

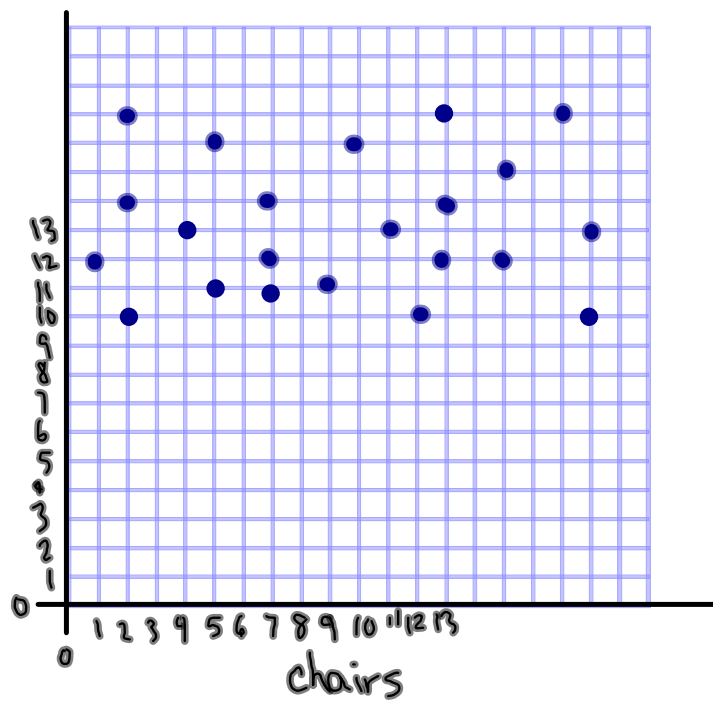
couches



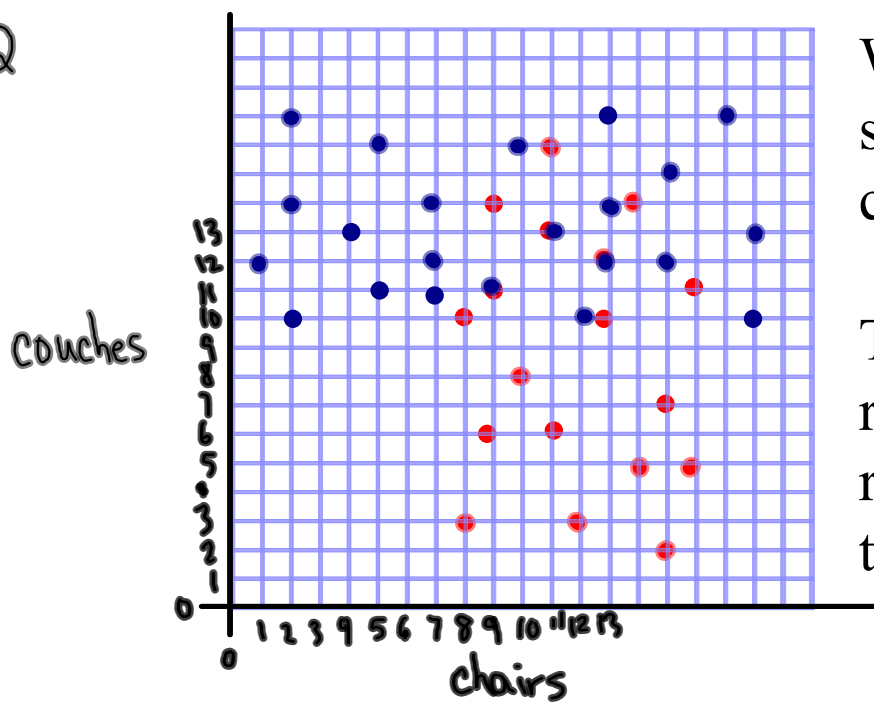
B)

Pg.312

couches



c)
Pg. 312



Which points satisfy both constraints?

The overlap region represents this!